MINERAL NUTRITION IN RELATION TO INFECTION OF THE TOMATO BY *SEPTORIA LYCOPERSICI SPEG.*

BY

RICHARD ALEXANDER CHAPMAN

B. S., Kent State University, 1940

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PLANT PATHOLOGY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1948

URBANA, ILLINOIS

1948

MINERAL NUTRITION IN RELATION TO INFECTION OF THE TOMATO BY *SEPTORIA LYCOPERSICI SPEG.*

BY

RICHARD ALEXANDER CHAPMAN

B. S., Kent State University, 1940

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PLANT PATHOLOGY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1948

URBANA, ILLINOIS

1948

ACKNOWLEDGMENT

The author takes this opportunity to express his sincere appreciation to Professor M. B. Linn for his interest and guidance in this work. It is also a pleasure to thank Professors H. W. Anderson, N. E. Stevens and O. Tippo for friendly counsel and assistance during the course of graduate studies. The advice of Professor H. W. Bean on the statistical aspects of this work is also greatly appreciated.

MINERAL NUTRITION IN RELATION TO INFECTION OF THE TOMATO BY *SEPTORIA LYCOPERSICI* SPEG.

Septoria leaf spot of tomatoes is one of the most destructive diseases of this crop in the United States, particularly in the Central States. Pritchard and Porte (3) investigated the effects of nitrogen, phosphorus, potassium, lime and copper sulfate on the development of this disease in plants grown in soil in the greenhouse. They concluded that conditions which are favorable for growth of the suscept increase susceptibility and vice versa.

In this investigation studies were made on the effects of some of the macronutrients (nitrogen, phosphorus, potassium) and of some of the micronutrients (manganese, zinc, copper, iron, boron) on the amount of infection of young plants grown in the greenhouse in sand and solution cultures. Investigation of the growth requirements of the pathogen in culture was also undertaken in an attempt to correlate some aspects of the nutrition of the pathogen with infection of the suscept.

A slight modification of the solution of Hoagland and Arnon (1) was used as the basic nutrient solution for the plant cultures. The elements studied were varied singly, from one-tenth to three times their concentration in this basic solution. Plants were inoculated when they were 35 to 42 days old. Because of the difference in size among plants receiving different nutrient treatments, relative amounts of infection were compared on the basis of the number of lesions per square decimeter of arbitrary plant areas determined by summing the squares of the lengths of individual leaves of plants. The data were treated statistically by the analysis of variance method.

Nitrogen was the only macronutrient associated with significant differences in amount of infection. Plants receiving the highest nitrogen level had the greatest number of lesions. Lesions on plants receiving the lowest level of nitrogen were relatively large and surrounded by bright yellow leaf tissue whereas those of plants receiving the most nitrogen were smaller and not bordered by yellow leaf tissue. Plants given the lowest level of nitrogen showed typical nitrogen-deficiency symptoms. One-third of the nitrogen in the nutrient solution containing the highest level of this element was in the form of the ammonium ion. The plants grown in this solution had the appearance of the carbohydrate-deficient plants described by Tiedjens and Robbins (5).

No significant differences in the amount of infection were obtained with different levels of phosphorus and potassium even though plants receiving the lowest level of these elements exhibited typical deficiency symptoms.

Manganese, copper and boron were the only micronutrients associated with significant differences in infection. Plants in the micronutrient experiments were grown both in sand and solution cultures with the exception of boron. Differences were more pronounced when plants were grown in solution cultures. Plants receiving the highest level of manganese had fewer lesions than those supplied with less manganese. Plants receiving the lowest level of manganese showed mild, manganese-deficiency symptoms. The trend for copper was in the same direction as that for manganese although no copper-deficiency symptoms were obtained. Plants receiving the highest level of boron had the greatest number of lesions. Plants supplied with the lowest level of boron exhibited mild, boron-deficiency symptoms.

No significant differences in amount of infection were obtained among plants grown in different levels of zinc and iron. Plants receiving the lowest level of iron showed mild, iron-deficiency symptoms but no zinc-deficiency symptoms

were obtained.

When all the micronutrients were varied simultaneously, keeping their ratio to one another constant, no significant differences in the amount of infection were obtained. It is thought that a disbalance of the micronutrients had a greater influence on infection than the presence or absence of certain quantities of individual elements.

A modification of Czapeck's sucrose-nitrate medium (2) which had been purified by the calcium carbonate method of Steinberg (4) was used for culturing the pathogen. It was necessary to supplement this medium with four gammas of thiamin per liter.

Copper was toxic to the pathogen in culture at a concentration of 0.01 p.p.m. when added to the medium alone. In the presence of the other micronutrients the toxicity level was raised to 0.5 p.p.m. This toxicity to the pathogen suggests that the reduction of infection on plants grown in nutrient solutions containing the highest copper levels may have been due to accumulation of this element in the plants.

When the micronutrients were added to the culture medium individually iron was the only one that resulted in increased growth. This element, at the rate of 2.0 p.p.m., doubled the growth of the pathogen. All possible combinations of the micronutrients, excluding iron, failed to increase growth. Zinc was toxic at 0.1 p.p.m. when added alone to the culture medium but in the presence of the other micronutrients at least 20.0 p.p.m. could be added without ill effect. Iron (2.0 p.p.m.) and zinc (0.01 p.p.m.) together gave greater growth increases than iron alone. Boron (0.5 p.p.m.) and manganese (1.0 p.p.m.) had little effect on growth of the pathogen.

LITERATURE CITED

1. Hoagland, D. R., and D. I. Arnon. The water-culture

method for growing plants without soil. Calif. Agr. Exp. Sta. Circ. 347. 1938.

2. Levine, M., and H. W. Schoenlein. A compilation of culture media for the cultivation of microorganisms. 969 pp. Baltimore. 1930.

3. Pritchard, F. J., and W. S. Porte. Effect of fertilizers and lime on the control of tomato leaf spot (*Septoria lycopersici*). Phytopath. 11:434-445. 1921.

4. Steinberg, R. A. Nutrient-solution purification for removal of heavy metals in deficiency investigations with *Aspergillus niger*. Jour. Agr. Res. 51:413-424. 1935.

5. Tiedjens, V. A., and W. R. Robbins. The use of ammonia and nitrate nitrogen by certain crop plants. N. J. Agr. Exp. Sta. Bul. 526. 1931.

VITA

The author was born in Akron, Ohio, on July 5, 1918, and attended the elementary schools of Akron and Silver Lake, Ohio. He graduated from Cuyahoga Falls High School, Cuyahoga Falls, Ohio, in 1935, and attended Kent State University, Kent, Ohio, receiving the B. S. degree in 1940. During the years 1940-1941 and 1941-1942 he carried on graduate study in Botany at the University of Illinois while serving as Graduate Assistant in Botany and Research Assistant in Horticulture. From 1942 to 1944 he was employed by Hiram Walker and Sons, Inc., at Peoria, Illinois, as a control chemist. From 1944 to 1946 he was on active duty with the United States Navy. He returned to the University of Illinois in 1946 as a Graduate Assistant in Botany and took up graduate work in Plant Pathology. During the year 1947-1948 he was a Graduate Fellow in Botany, receiving the Ph. D. degree in June, 1948.

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549818_0267